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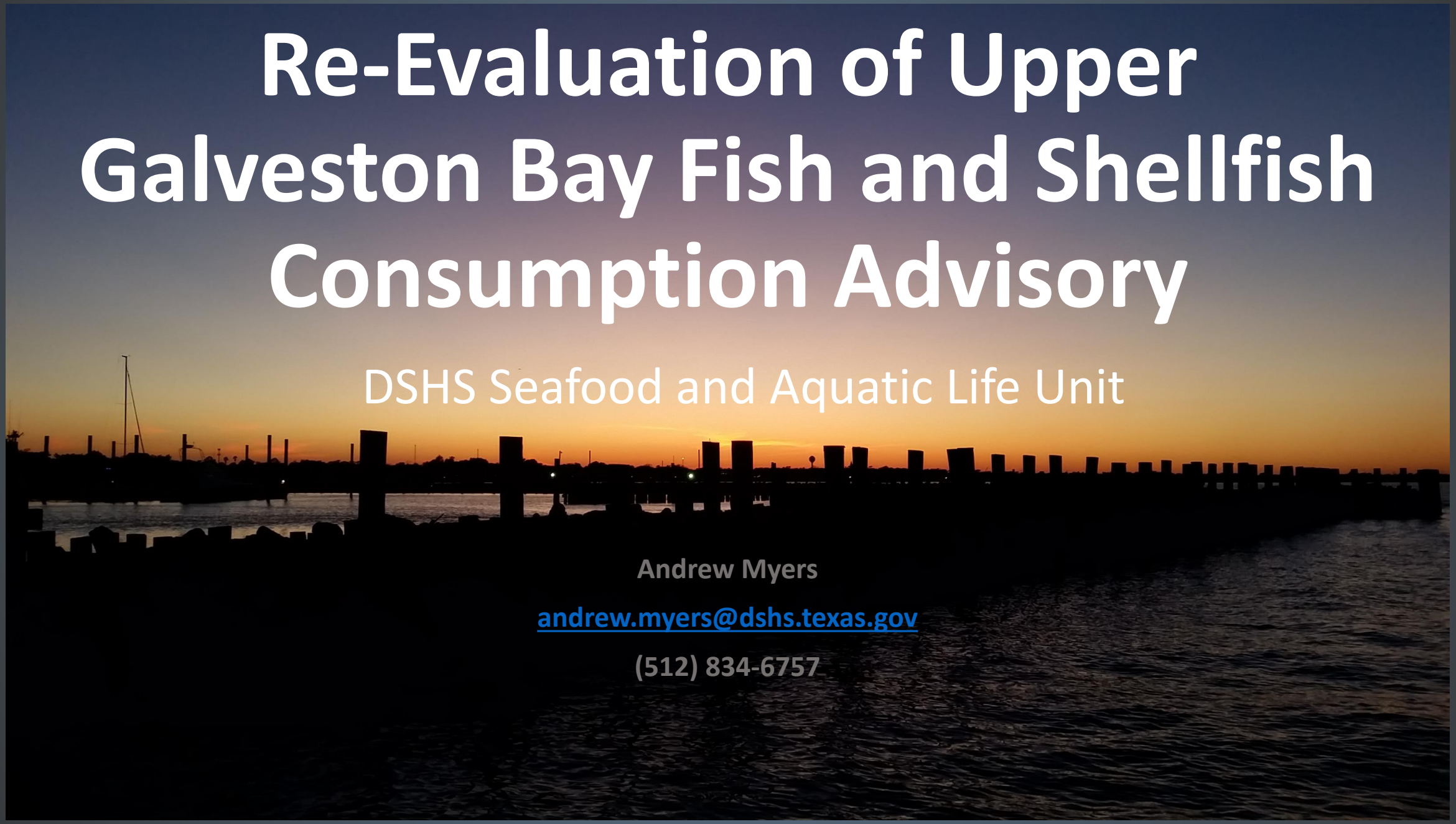
Health and Human Services

Texas Department of State Health Services

Re-Evaluation of Upper Galveston Bay Fish and Shellfish Consumption Advisory

DSHS Seafood and Aquatic Life Unit



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Funding and Oversight

Funding Source:
Clean Water Act §320
Federal Grant # CE – 00655006
EPA Q-TRAK # 19-113

History of Local Advisory

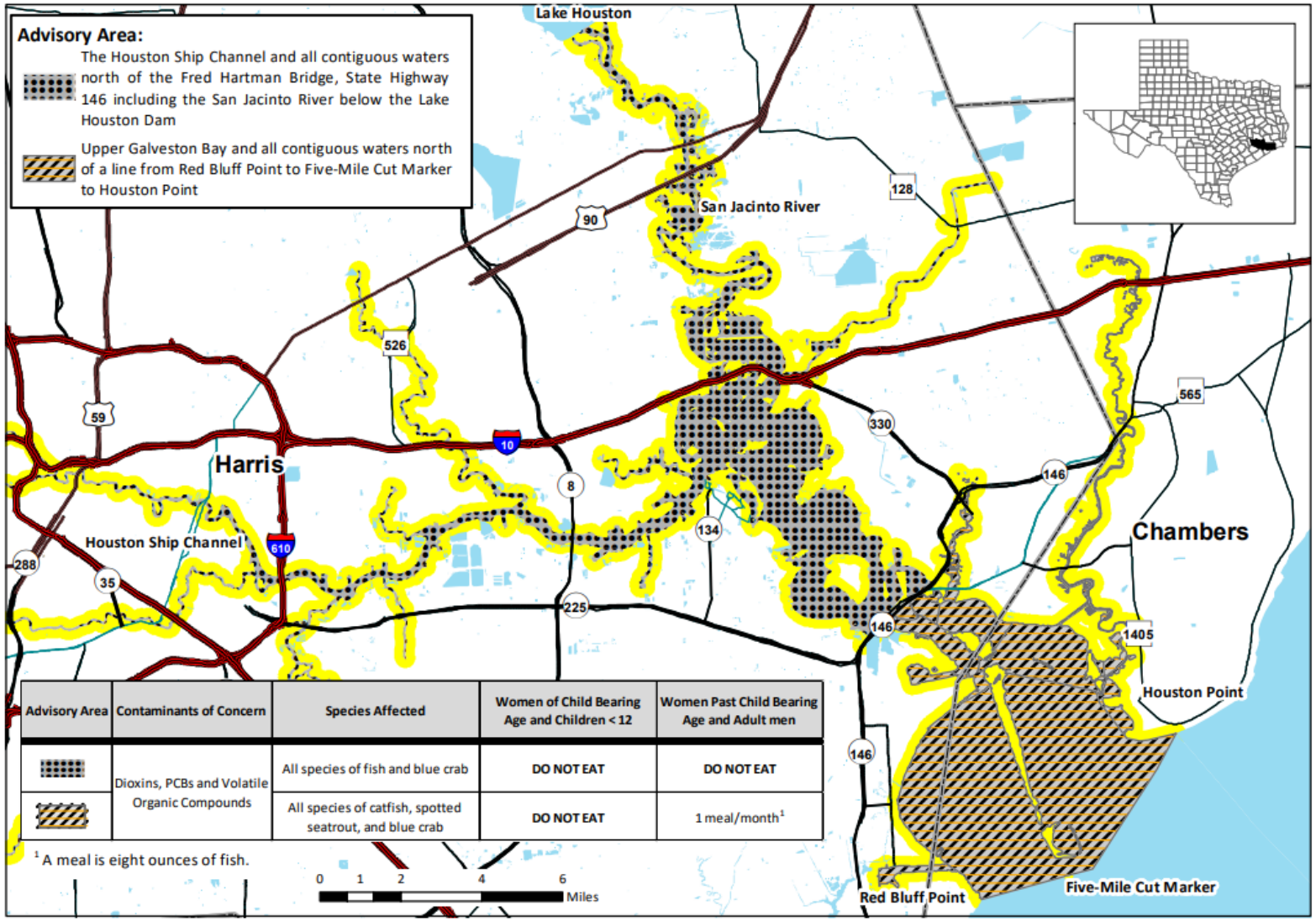
- 1986 EPA discovered dioxin congeners in fish and shellfish tissue.
- 1990 TDH found PCDFs (furans) and PCDDs (dioxins) in catfish species and blue crab at concentrations that could pose risk to health and issued Fish and Shellfish Consumption Advisory 3 (ADV 3).
- 1994, 1996, and 1999 DSHS studies Upper Galveston Bay supported continuance of ADV 3 consumption advice.
- 2006 and 2007 DSHS found catfish and spotted seatrout from Galveston Bay to contain dioxins and PCBs at concentrations that could pose risk to health and issued Fish and Shellfish Consumption Advisory 35 (ADV 35).

History of Local Advisory

- 2013 DSHS sampling of sites within the Galveston Bay complex including Upper Galveston Bay again found blue crab, catfish and seatrout to contain PCBs and PCDDs/PCDFs exceeding health assessment guidelines and issued Fish and Shellfish Consumption Advisory 50.
- 2015 DSHS detected a reduction in organochlorine pesticides and removed them as contaminate of concern for Houston Ship Channel and Lower San Jacinto River in the issuance of Fish and Shellfish Consumption Advisory 55. (Did not alter consumption advice for Upper Galveston Bay.)
- 2019 DSHS modified ADV 55 due to ITC incident, to recommend no one eat any fish or crab from the Houston Ship Channel.

Current Advisory

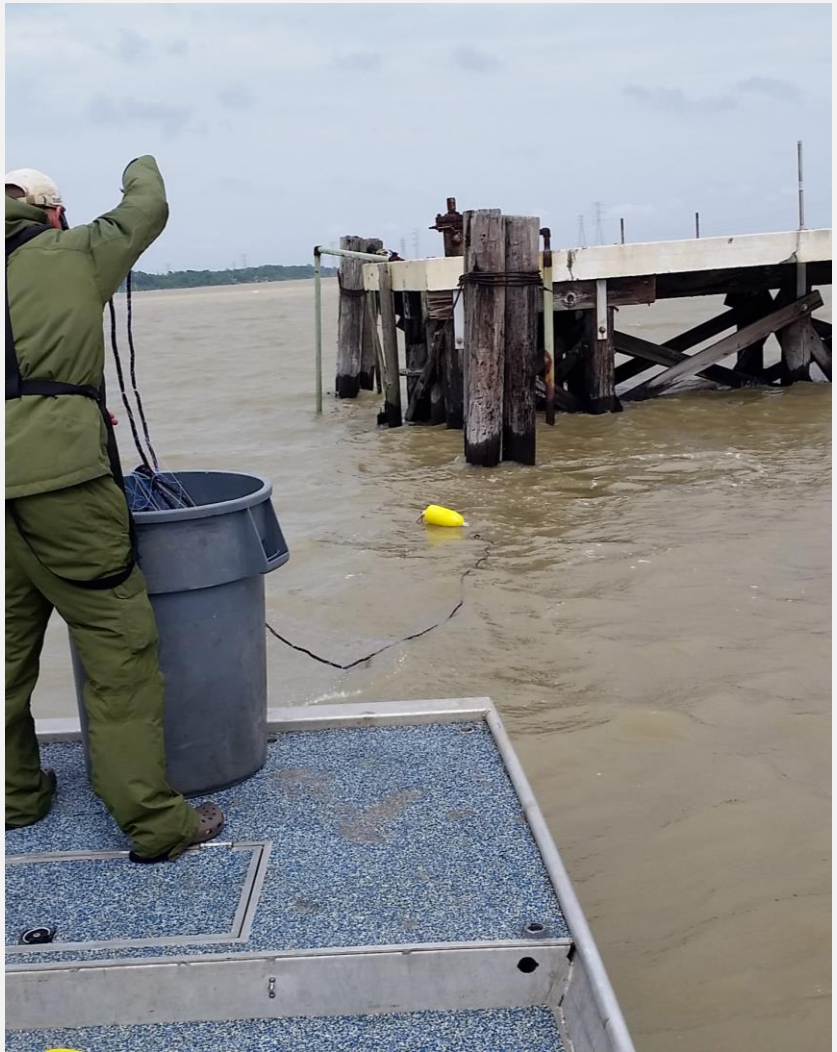
Galveston Bay Estuary (Map 1) – Houston Ship Channel, San Jacinto River, and Upper Galveston Bay
Chambers and Harris Counties
ADV-55 Issued December 18, 2015; Rescinding ADV-49; ADV-50 Issued June 26, 2013; Modified March 27, 2019



Advisory Area	Contaminants of Concern	Species Affected	Women of Child Bearing Age and Children < 12	Women Past Child Bearing Age and Adult men
	Dioxins, PCBs and Volatile Organic Compounds	All species of fish and blue crab	DO NOT EAT	DO NOT EAT
		All species of catfish, spotted seatrout, and blue crab	DO NOT EAT	1 meal/month[1]

[1] A meal is eight ounces of fish.

Passive Sampling



Gillnets and Crab Traps

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Active Sampling

Hook and Line

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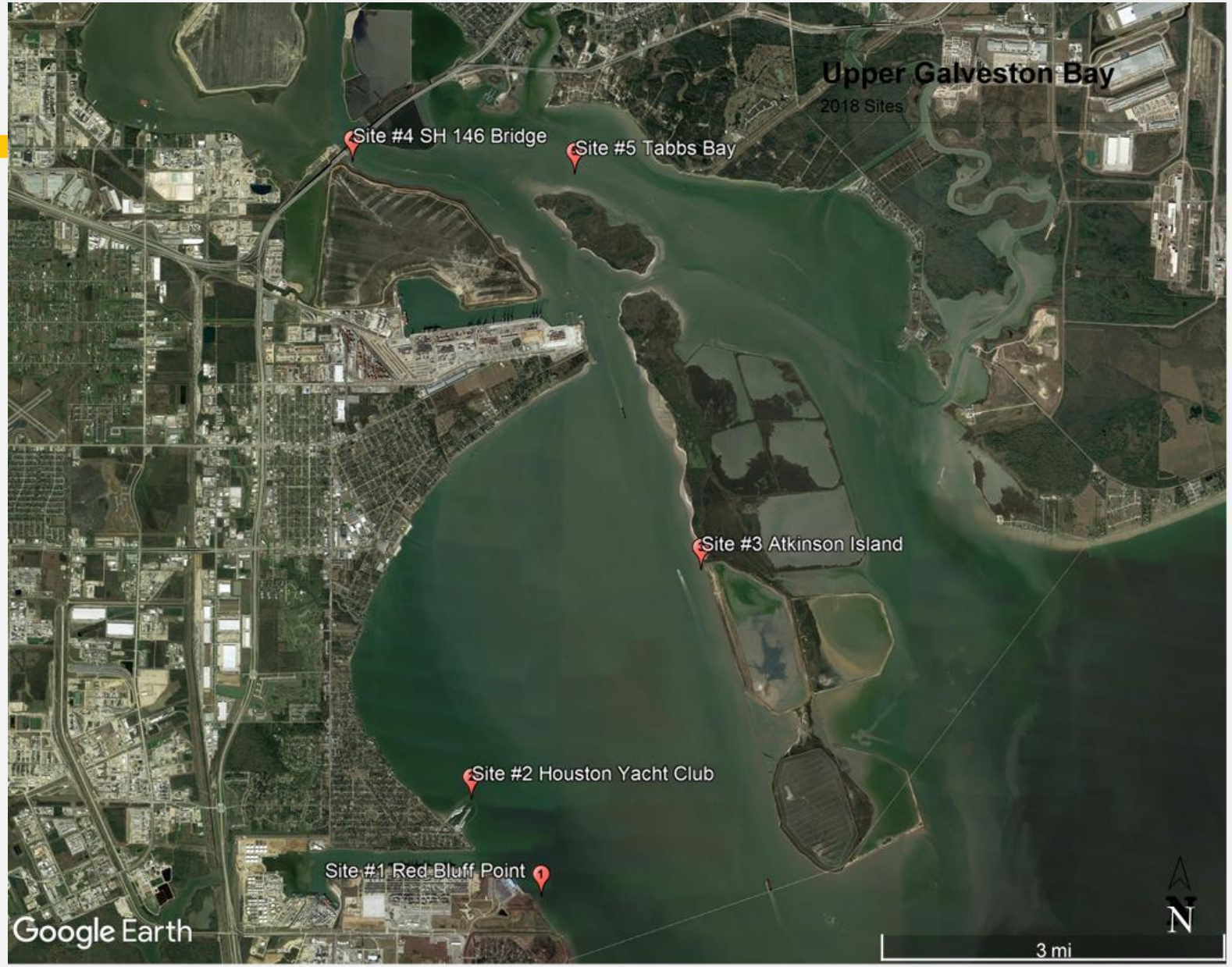
Upper Galveston Bay Sample Sites 2018

1. Red Bluff Point
2. Houston Yacht Club
3. Atkinson Island
4. SH 146 Bridge
5. Tabbs Bay

Black Duck Bay was sampled, but no viable target species were collected.



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Sample Distribution

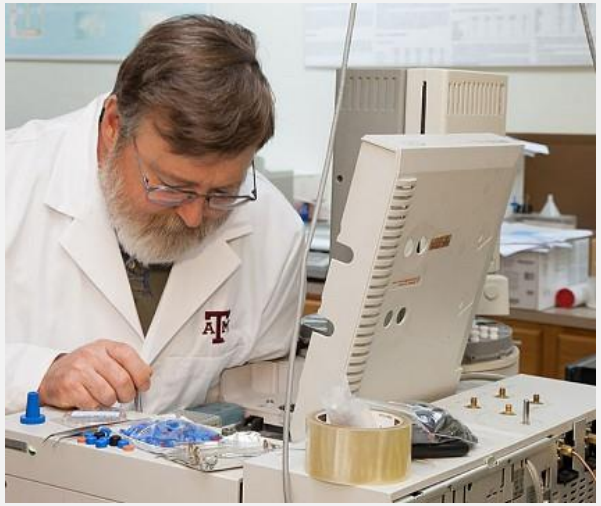
Species	Number Analyzed	Red Bluff Pt.	Houston Yacht	Atkinson Island	SH 146 Bridge
Gaftopsail catfish	32	4	25	0	3
Spotted sea trout	26	13	13	0	0
Blue crab (composites)	9	2	3	3	1
Total	67	20	41	3	4

* Though sampled, no target species were collected from Tabbs and Black Duck Bays.

Sample Preparation

Target Analytes

- Dioxins (17 congeners)
- Metals (arsenic, cadmium, copper, lead, mercury, selenium, and zinc)
- Pesticides (34)
- PCBs (209 congeners)
- SVOCs (123)
- VOCs (70)



Sample Analysis

Species	Number Analyzed	Dioxins	PCBs	Pest.	SVOCs	VOCs	Metals
Gaftopsail catfish	32	32	32	10	10	10	10
Spotted sea trout	26	26	26	0	0	0	0
Blue crab (composites)	9	9	9	0	0	0	0
Total	67	67	67	10	10	10	10

*In an effort to attain statistically valid data, and compare previous datasets, one species (gafftopsail catfish) was selected to represent the entire subset.

Toxicity Values

- **Non-Carcinogenic Effects (e.g., effects on the immune, reproductive, nervous, and endocrine systems, etc.)**
  - Agency for Toxic Substances and Disease Registry (ATSDR)
    - Minimal risk level (MRL)
      - http://www.atsdr.cdc.gov/mrls/index.asp
  - EPA Integrated Risk Information System (IRIS)
    - Reference dose (RfD)
      - http://www.epa.gov/IRIS/
- **Carcinogenic Effects**
  - EPA IRIS
    - Cancer slope factor (CSF)

What is a Hazard Quotient (HQ) and Hazard Index (HI)?

- A hazard quotient (HQ) is the ratio of the estimated exposure dose of a contaminant to its RfD or MRL.
  - **HQ = (MCC x CR) / BW) / RfD**
- A hazard index (HI) is the sum of HQs for contaminants that affect the same target organ or organ system or have similar toxicity profiles.
- Systemic (non-cancer) health effects are unlikely from consumption of fish for which the HQ or HI is less than 1.0.

HQ= (Concentration x Consumption rate) / Body weight / Reference dose or Minimum risk levels

Results

Mercury (mg/kg) in fish Gafftopsail catfish collected from Upper Galveston Bay, 2018.

Species	Number Detected/ Number Tested	Mean ± S.D. (Min-Max)	HAC Value (nonca; mg/kg)	Basis for Comparison Value
Gafftopsail catfish	10/10	0.290±0.079 (0.186-0.425)	0.7	ATSDR Chronic Oral MRL for Methylmercury — 0.0003 mg/kg–day

Arsenic (mg/kg) in Gafftopsail catfish collected from Upper Galveston Bay, 2018.

Species	Number Detected/ Number Tested	Total Arsenic Mean ± S.D. (Min-Max)	Inorganic Arsenic Mean	HAC Value (nonca) and HAC Value (ca; mg/kg)	Basis for Comparison Value
Gafftopsail catfish	10/10	0.973±0.449 (0.360-1.660)	0.097	0.700 0.363	EPA Chronic Oral RfD for Inorganic Arsenic — 0.0003 mg/kg–day EPA Oral Slope Factor for Inorganic Arsenic — 1.5 per mg/kg–day

Most arsenic in fish and shellfish occurs as organic arsenic, considered virtually nontoxic. For risk assessment calculations, DSHS assumes that total arsenic is composed of 10% inorganic arsenic in fish and shellfish tissues.

Derived from the MRL or RfD for noncarcinogens or the EPA slope factor for carcinogens; assumes a body weight of 70 kg, and a consumption rate of 30 grams per day, and assumes a 30-year exposure period for carcinogens and an excess lifetime cancer risk of $1x10^{-4}$.

Results

Pesticides (mg/kg) in Gafftopsail catfish collected from Upper Galveston Bay.				
Species	**Number Detected/ Number Tested**	**Mean ± S.D. (Min-Max)**	**HAC Value (nonca) and HAC Value (ca; mg/kg)**	**Basis for Comparison Value**
Chlordane (total)				
All sites combined	10/10	0.0136±0.0112 (0.0034 -0.0397)	1.167 1.556	EPA Chronic Oral RfD — 0.0005 mg/kg–day EPA Oral Slope Factor — 0.35 per mg/kg–day
DDT (total)				
All sites combined	10/10	0.0181±0.0091 (0.0065 -0.0345)	1.167 1.601	EPA Chronic Oral RfD — 5.0E-4 mg/kg–day EPA Oral Slope Factor — 3.4E-1 per (mg/kg)/day
Dieldrin				
All sites combined	10/10	0.0021±0.0018 (0.0004 -0.0064)	0.117 0.034	EPA Chronic Oral RfD — 0.00005 mg/kg–day EPA Oral Slope Factor — 16 per (mg/kg)/day
Endrin				
All sites combined	10/10	0.0037±0.0045 (0.0009 -0.0160)	0.700	EPA Chronic Oral RfD — 3.0E-4 (mg/kg)/day
Heptachlor Epoxide				
All sites combined	10/10	0.0005±0.0003 (BDL -0.0010)	0.030 0.060	EPA Chronic Oral RfD — 1.3E-5 mg/kg–day EPA Oral Slope Factor — 9.1E+0 per (mg/kg)/day
Hexachlorobenzene				
All sites combined	10/10	0.0009±0.0009 (BDL -0.0023)	1.867 0.340	EPA Chronic Oral RfD — 8.0E-4 mg/kg–day EPA Oral Slope Factor — 1.6E+0 per (mg/kg)/day

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Results

PCBs (mg/kg) in fish collected from Upper Galveston Bay by species, 2018.

Species	Number Detected/ Number Tested	Mean ± S.D. (Min-Max)	HAC Value (nonca) and HAC Value (ca; mg/kg)	Basis for Comparison Value
Blue crab	9/9	0.009±0.005 (0.006-0.020)	0.047	EPA Chronic Oral RfD for Aroclor 1254 — 0.00002 mg/kg–day
Gafftopsail catfish	32/32	**0.122**±0.056 (0.032-**0.233**)		
Spotted seatrout	26/26	**0.068**±0.027 (0.019-**0.142**)	0.272	EPA Slope Factor — 2.0 per mg/kg–day
All fish combined	67/67	**0.086**±0.057 (0.006-**0.233**)		

PCDDs/PCDFs toxicity equivalent (TEQ) concentrations (pg/g) in fish collected from Galveston Bay by species, 2018.

Species	Number Detected/ Number Tested	Mean ± S.D. (Min-Max)	HAC Value (nonca) and HAC Value (ca; pg/g)	Basis for Comparison Value
Blue crab	9/9	0.821±0.650 (0.090-**2.160**)	1.63	EPA RfD of 7.0×10^{-10} mg/kg/day
Gafftopsail catfish	32/32	**3.655**±2.237 (0.980-**9.540**)		
Spotted seatrout	26/26	0.591±0.356 (0.060-1.320)	3.49	EPA Slope Factor — 1.56×10^{5} per mg/kg–day
All fish combined	67/67	**2.085**±2.178 (0.060-**9.540**)		

* Embolden text in table implies concentration exceeds DSHS Health Assessment Comparison (HAC) value.

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Results

Semivolatile organic compounds (mg/kg) in fish collected from the Upper Galveston Bay, 2018.				
Species	**Number Detected/ Number Tested**	**Mean ± S.D. (Min-Max)**	**HAC Value (nonca; mg/kg)**	**Basis for Comparison Value**
Benzoic acid				
Gafftopsail catfish	9/10	0.055±0.016 (BDL -0.101)	9333.333	EPA Chronic Oral RfD — 4.0E+0 mg/kg–day
Bis (2-ethylhexyl) phthalate				
Gafftopsail catfish	9/10	0.059±0.028 (ND -0.138)	N/A	N/A
Diethyl phthalate				
Gafftopsail catfish	10/10	BDL±0.000 (BDL -BDL)	N/A	N/A

Volatile organic compounds (mg/kg) in fish collected from the Upper Galveston Bay, 2018.				
Species	**Number Detected/ Number Tested**	**Mean ± S.D. (Min-Max)**	**HAC Value (nonca; mg/kg)**	**Basis for Comparison Value**
Acetone				
Gafftopsail catfish	10/10	0.144±0.082 (BDL -0.264)	700	EPA Chronic Oral RfD — 3.0E-1 (mg/kg)/day
Methylene chloride				
Gafftopsail catfish	10/10	0.016±0.027 (0.013 -0.021)	700	EPA Chronic Oral RfD — 3.0E-1 (mg/kg)/day
Trichlorofluoromethane				
Gafftopsail catfish	10/10	0.050±0.027 (BDL -0.090)	700	EPA Chronic Oral RfD — 3.0E-1 (mg/kg)/day

- BDL indicates concentration was below detection limit.
- ND indicated non-detect

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Exposure Assumptions

- **Consumer Body Weight**
  - Adult = 70 kg (154 lb)
  - Children < 12 = 35 kg (77 lb)
  - Children < 6 = 15 kg (33 lb)
- **Consumption Rate**
  - Adult = 0.030 kg/day (equiv. to one 8-oz meal/week)
  - Children = 0.015 kg/day (equiv. to one 4-oz meal/week)
- **Acceptable Risk Level**
  - $1x10^{-4}$ or 1 excess cancer in 10,000 persons equally exposed
- **Exposure Period**
  - 30 years, assuming a 70-year lifetime

Non-Cancer Risk Calculation

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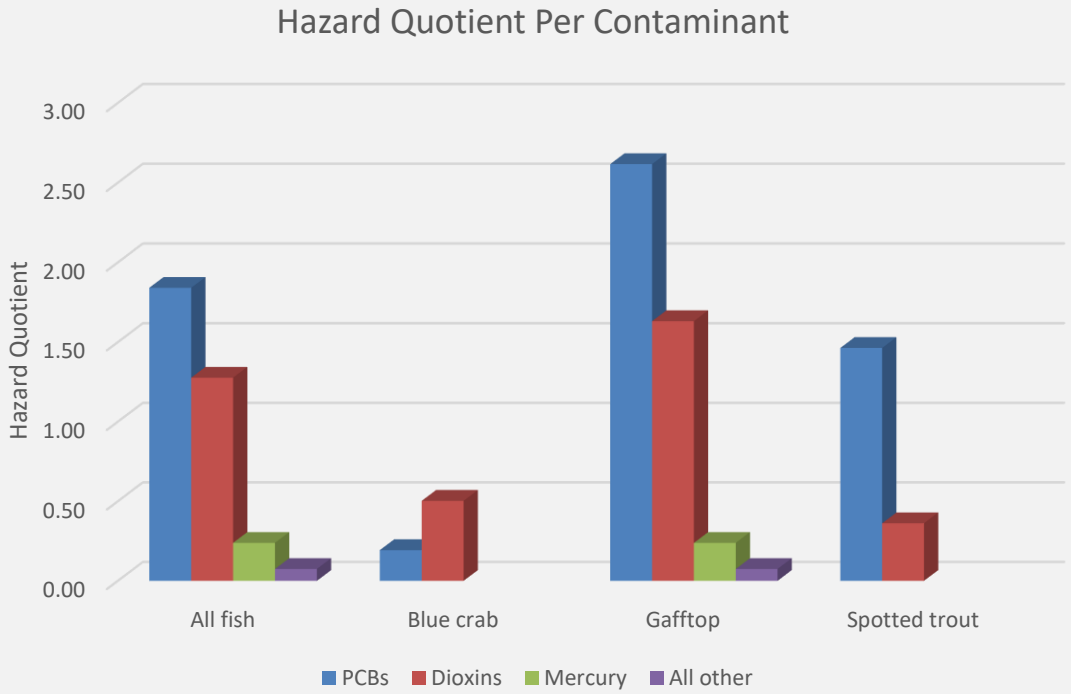
Hazard quotients (HQs) and hazard indices (HIs) for PCBs and/or PCDDs/PCDFs in fish collected from Galveston Bay in 2018. This table also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults.

Contaminant/Species	Number of Samples	Hazard Quotient	Meals per Week
Blue crab			
PCBs	9	0.19	4.8
PCDDs/PCDFs		0.50	1.8
Hazard Index (meals per week)		0.68	1.4
Gafftopsail catfish			
PCBs	32	**2.62**	**0.4**
PCDDs/PCDFs		**1.63**	**0.6**
Hazard Index (meals per week)		**4.25**	**0.2**
Spotted seatrout			
PCBs	26	**1.46**	**0.6**
PCDDs/PCDFs		0.36	11.1
Hazard Index (meals per week)		**1.83**	**0.5**
All fish and crab			
PCBs	67	**1.84**	**0.5**
PCDDs/PCDFs		**1.28**	**0.7**
Hazard Index (meals per week)		**3.12**	**0.3**

- DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.
- Emboldened numbers denote that the HQ or HI is ≥ 1.0.
- Emboldened numbers denote that the calculated allowable meals for an adult are ≤ 1.0 meal per week.

Risk (Non-cancer) per contaminant



	All fish	Blue crab	Gafftopsail catfish	Spotted seatrout
PCBs	1.84	0.19	2.62	1.46
Dioxins	1.28	0.50	1.63	0.36
Mercury	0.24	N/A	0.24	N/A
All other contaminants	0.31	N/A	0.31	N/A

Cancer Slope Factor

An upper bound, approximating a 95% confidence limit, on the increased cancer risk from a lifetime exposure to an agent by ingestion or inhalation.

- Used to estimate the risk of cancer associated with exposure to a carcinogenic or potentially carcinogenic substance
- Risk per unit dose
- Units of risk $(mg/kg\text{-}day)^{-1}$

Cancer Risk Calculation

Calculated theoretical lifetime excess cumulative cancer risk from consuming fish collected in 2018 from Galveston Bay containing carcinogens and suggested consumption rate (eight-ounce meals/week) for 70 kg adults who regularly eat fish from Galveston Bay over a 30-year period.

Species/Contaminant	Number of Samples	Theoretical Lifetime Excess Cancer Risk		Meals per Week
		Risk	Population Size that Would Result in One Excess Cancer	
Blue crab				
PCBs	9	3.3E-06	302,469	unrestricted
PCDDs/PCDFs		2.4E-05	42,504	3.9
Cumulative Cancer Risk		2.7E-05	37,680	3.5
Gafftopsail catfish				
Arsenic	10	1.7E-05	604,938	2.1
Chlordane		3.02E-7	3,309,693	unrestricted
Dieldren		8.8E-07	1,134,259	unrestricted
DDT		3.93E-07	2,541,757	unrestricted
PCBs	32	4.5E-05	22,295	2.1
PCDDs/PCDFs		7.6E-05	13,096	1.2
Cumulative Cancer Risk		**1.2E-04**	**8,036**	**0.7**
Spotted seatrout				
PCBs	26	2.5E-05	39,857	3.7
PCDDs/PCDFs		1.7E-05	59,073	5.5
Cumulative Cancer Risk		4.2E-05	23,799	2.2
All fish				
Arsenic	10	1.7E-06	604,938	2.1
Chlordane		3.02E-7	3,309,693	unrestricted
Dieldren		8.8E-07	1,134,259	unrestricted
DDT		3.93E-07	2,541,757	unrestricted
PCBs	67	3.2E-05	31,691	2.9
PCDDs/PCDFs		6.0E-05	16,737	1.5
Cumulative Cancer Risk		**9.5E-05**	**10,578**	**1.0**

- DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.
- Emboldened numbers denote that calculated excess lifetime cancer risk after 30 years exposure is greater than 1.0E-04.
- Emboldened numbers denote that the calculated allowable meals for an adult are ≤ 1.0 meal per week.

Conclusions

(Based solely on current dataset)

Table 10. SALG recommended fish consumption advice for apportion of Galveston Bay, 2018.			
Contaminants of Concern	**Species**	**Women of childbearing age and children < 12**	**Women past childbearing age and males 12 and older**
Dioxins and PCBs	Gafftopsail catfish	**DO NOT EAT**	**DO NOT EAT**
	Spotted seatrout	2 meals/month	2 meals/month

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Thank you!

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